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(71) Applicant: **United Technologies Corporation**
Farmington, CT 06032 (US)

(72) Inventors:
- **CAPRARIO, Joseph T.**
  Rocky Hill, CT Connecticut 06067 (US)
- **WADSWORTH, Noah**
  Sturbridge, MA Massachusetts 01566 (US)
- **MARLER, Mark E.**
  Glastonbury, CT Connecticut 06033 (US)
- **ALLORE, James P.**
  South Windsor, CT Connecticut 06074 (US)
- **VINSON, Elizabeth F.**
  Broad Brook, CT Connecticut 06016 (US)

(74) Representative: **Hall, Matthew Benjamin**
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) RETAINING RING END GAP FEATURES

(57) A gas turbine engine (10) and a retaining ring (110) are disclosed. The gas turbine engine includes a rotating disc assembly (35), including a rotating disc (102), a cover plate (104), and a retaining ring (110) disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, the retaining ring including a rotating disc face (112) to interface with the rotating disc; a cover plate face (114) to interface with the cover plate; and an end gap portion (120) defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

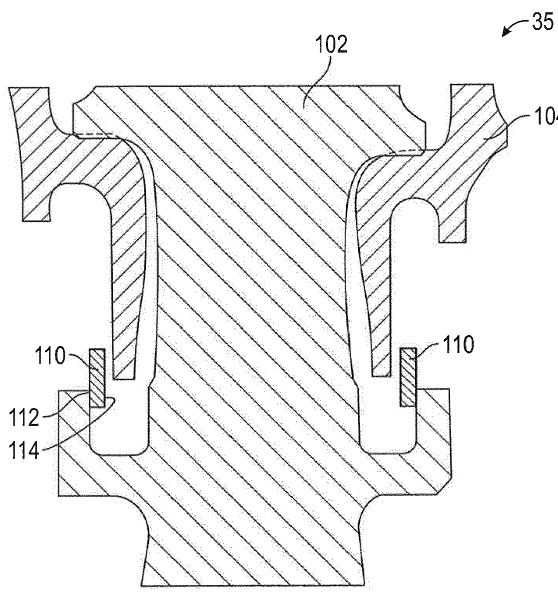

FIG. 2

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Description

BACKGROUND

[0001] The present disclosure relates to retaining rings for gas turbine engines, and more particularly to retaining rings with end gap features for gas turbine engines.

[0002] Retaining rings for gas turbine engines can be utilized to retain a cover plate to a rotating disc within the engine. During operation, stress concentrations may form within the cover plate at the location of the retaining ring end gap that may cause contact stress and cracking.

[0003] Accordingly, it is desirable to provide retaining rings with end gap features that can prevent stress concentrations within the cover plate.

BRIEF SUMMARY

[0004] According to an embodiment, a retaining ring for use in a gas turbine engine includes a rotating disc face, a cover plate face, and an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

[0005] In addition to one or more of the features described above, or as an alternative, further embodiments could include an axially extending face extending from the cover plate face.

[0006] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the axially extending face includes the stress reducing feature.

[0007] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

[0008] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a contoured contact surface.

[0009] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a scalloped surface.

[0010] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a tapering surface.

[0011] According to an embodiment, a rotating disc assembly for use with a gas turbine engine includes a rotating disc, a cover plate, and a retaining ring disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, the retaining ring including a rotating disc face to interface with the rotating disc, a cover plate face to interface with the cover plate, and an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

[0012] In addition to one or more of the features described above, or as an alternative, further embodiments could include an axially extending face extending from the cover plate face, wherein the axially extending face radially constrains the retaining ring against the cover plate.

[0013] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the axially extending face includes the stress reducing feature.

[0014] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

[0015] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a contoured contact surface.

[0016] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a scalloped surface.

[0017] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a tapering surface.

[0018] According to an embodiment, a gas turbine engine includes a rotating disc assembly, including a rotating disc, a cover plate, and a retaining ring disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, the retaining ring including: a rotating disc face to interface with the rotating disc; a cover plate face to interface with the cover plate; and an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

[0019] In addition to one or more of the features described above, or as an alternative, further embodiments could include an axially extending face extending from the cover plate face, wherein the axially extending face radially constrains the retaining ring against the cover plate.

[0020] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the axially extending face includes the stress reducing feature.

[0021] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

[0022] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a contoured contact surface.

[0023] In addition to one or more of the features described above, or as an alternative, further embodiments could include that the stress reducing feature is a scalloped surface.

[0024] Other aspects, features, and techniques of the embodiments will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The subject matter which is regarded as the present disclosure is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the present disclosure are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a schematic, partial cross-sectional view of a turbomachine in accordance with this disclosure;

Fig. 2 is partial cross-sectional view of a rotating disc assembly for use with the turbomachine of Fig. 1;

Fig. 3 is a partial plan view of the rotating disc assembly of Fig. 2;

Fig. 4 is a partial cross-sectional view of another rotating disc assembly for use with the turbomachine of Fig. 1;

Figs. 5A-5C are partial end views of various embodiments of retaining rings for use with the rotating disc assembly of Fig 4;

Figs 6A-6F are partial plan views of various embodiments of retaining rings for use with the rotating disc assembly of Fig. 4; and

Figs. 7A-7F are partial elevation views of various embodiments of retaining rings for use with the rotating disc assembly of Fig. 4.

DETAILED DESCRIPTION

[0026] Embodiments provide a retaining ring with end gap features. The end gap features of the retaining ring can reduce contact stress on the cover plate during operation to prevent wear and improve life of the rotating disc assembly.

[0027] Referring to FIG. 1 a schematic representation of a gas turbine engine 10 is shown. The gas turbine engine includes a fan section 12, a compressor section 14, a combustor section 16, and a turbine section 18 disposed about a longitudinal axis A. The fan section 12 drives air along a bypass flow path B that may bypass the compressor section 14, the combustor section 16, and the turbine section 18. The compressor section 14 draws air in along a core flow path C where air is compressed by the compressor section 14 and is provided to or communicated to the combustor section 16. The compressed air is heated by the combustor section 16 to generate a high pressure exhaust gas stream that expands through the turbine section 18. The turbine section 18 extracts energy from the high pressure exhaust gas stream to drive the fan section 12 and the compressor section 14.

[0028] The gas turbine engine 10 further includes a low-speed spool 20 and a high-speed spool 22 that are configured to rotate the fan section 12, the compressor section 14, and the turbine section 18 about the longitudinal axis A. The low-speed spool 20 may connect a fan 30 of the fan section 12 and a low-pressure compressor portion 32 of the compressor section 14 to a low-pressure turbine portion 34 of the turbine section 18. In the illustrated embodiment, the turbine section 18 can include a rotating disc assembly 35. The high-speed spool 22 may connect a high pressure compressor portion 40 of the compressor section 14 and a high pressure turbine portion 42 of the turbine section 18. The fan 30 includes a fan rotor or fan hub 50 that carries a fan blade 52. The fan blade 52 radially extends from the fan hub 50.

[0029] In the illustrated embodiment, the rotating disc assembly 35 can be a turbine disc assembly to extract energy from the high pressure exhaust gas stream by rotation of a plurality of turbine discs. The turbine disc assembly can utilize retaining rings to retain turbine discs and cover plates within the gas turbine engine 10. In certain embodiments, the compressor portion 32 can include a similar rotating disc assembly 35 to compress airflow by rotation of a plurality of compressor discs. The compressor disc assembly can utilize retaining rings to retain compressor discs and cover plates within the gas turbine engine 10.

[0030] Referring to FIG. 2, a rotating disc assembly 35 is shown. The rotating disc assembly 35 can be any suitable assembly, including, but not limited to a turbine disc assembly or a compressor disc assembly. In the illustrated embodiment, the rotating disc assembly 35 includes a rotating disc 102, a cover plate 104, and a retaining ring 110. The retaining ring 110 can prevent axial motion of the cover plate 104 relative to the rotating disc 102 to allow the rotating disc 102 and the cover plate 104 to be retained after assembly. The retaining ring 110 can be mounted against the lip of the rotating disc 102 to retain the cover plate 104 after assembly. In the illustrate embodiment, multiple retaining rings 110 can be disposed on either side of the rotating disc 102 to prevent axial motion on either side of the rotating disc assembly 35. In certain embodiments, rotating disc 102 can be a disc segment and other parts that are not complete discs. In certain embodiments, the rotating disc assembly 35 is suitable for use with parts to be retained that are not rotating.

[0031] Referring to FIGS. 2 and 3, the retaining ring

110 includes a rotating disc face 112, a cover plate face 114, and an end gap portion 120. The retaining ring 110 is a split ring that axially interfaces with the lip portion of the rotating disc 102 and the cover plate 104 via the rotating disc face 112 and the cover plate face 114 respectively. In certain embodiments, the retaining ring 110 can be formed from additive manufacturing processes, casting processes, machining processes or a combination thereof. Any other suitable process for manufacturing the retaining ring 110 is contemplated herein.

[0032] The split ring construction of the retaining ring 110 allows for an end gap formed between the end gap portions 120. Advantageously, with the use of the stress reducing geometries and features described herein, contact stresses of the cover plate 104 near the end gap defined by the end gap portions 120 can be reduced to improve life of the rotating disc assembly.

[0033] Referring to FIG. 3, the retaining ring 110 includes two tapered surfaces proximal to the end gap defined by the end gap portions 120. In the illustrated embodiment, the cover plate face 114 includes a tapered surface in the end gap portion 120. In the illustrated embodiment, the cover plate face 114 tapers away from the cover plate 104 to reduce stress concentrations experienced by the cover plate 104. Similarly, in the illustrated embodiment, the rotating disc face 112 includes a tapered surface in the end gap portion 120. In the illustrated embodiment, the rotating disc face 112 tapers away from the rotating disc 102 to reduce stress concentrations experienced by the cover plate 104.

[0034] Further referring to FIG. 4, in certain embodiments, the retaining ring 110 includes an axially extending face 115. In the illustrated embodiment, the axially extending face 115 extends inward from the cover plate face 114 to form a general "L" shape. The axially extending face 115 can provide radial support to the cover plate 104 and further aid in assembly by locating the cover plate 104 and the retaining ring 110 during assembly. In certain embodiments, the axially extending face 115 can aid in reducing stress on the retaining ring 110 and the cover plate 104.

[0035] Referring to FIGS. 5A-7F, various embodiments of retaining rings 110 with various stress reducing features are shown and described. Stress reducing features and geometries described herein can be combined to form a desired retaining ring to provide a desired level of stress distribution and stiffness. Features and geometries can be combined in any suitable combination and can be machined, internally formed, additively manufactured, etc. In the illustrated embodiments, the stress reducing features can be proximal to the end gap portions 120 of the retaining ring 110.

[0036] Referring to FIGS. 5A-5C, various embodiments of a retaining ring 110 are shown. In FIGS. 5A-5C, an end view of the end gap portion 120 of the retaining ring 110 is shown. In FIG. 5A, a retaining ring 110 is shown without any stress reducing features present on the rotating disc face 112, the cover plate face 114, or the axially extending face 115. In certain applications, the use of a retaining ring 110 without any stress reducing features may cause high stress concentrations on the cover plate 104. In FIG. 5B, the retaining ring 110 is shown with stress reducing features 114a, 114b. In the illustrated embodiment, stress reducing features 114a, 114b are radiused corners that are tangent to the cover plate face 114. In the illustrated embodiment, the stress reducing feature 114b is also a radiused corner tangent to the axially extending face 115. In FIG. 5C, the retaining ring 110 is shown with stress reducing features 114a, 114b. In the illustrated embodiment, stress reducing features 114a, 114b are contoured contact surfaces formed on the cover plate face 114. In the illustrated embodiment, the stress reducing feature 114a can be a contoured contact surface with the cover plate 104.

[0037] Referring to FIGS. 6A-6F, various embodiments of the retaining ring 110 are shown. In FIGS. 6A-6F, a plan view of the end gap portion 120 of the retaining ring 110 is shown. In the illustrated embodiments, the axially extending face 115 can extend any suitable distance both axially in radially. In certain embodiments, the axially extending face 115 can end before the end gap portion 120 or alternatively extend beyond the end gap portion 120. In FIG. 6A, a retaining ring 110 is shown with stress reducing features 120a. In the illustrated embodiment, the stress reducing feature 120a is a radiused corner that is tangent to the cover plate face 114 and the rotating disc face 112. Further, the stress reducing feature 120a is disposed on the end gap portion 120 of the retaining ring 110. In FIG. 6B, a retaining ring 110 is shown with stress reducing features 120a. In the illustrated embodiment, the stress reducing feature 120a is a chamfered or contoured corner that transitions to the cover plate face 114 and the rotating disc face 112. In FIG. 6C, a retaining ring 110 is shown with stress reducing features 120a. In the illustrated embodiment, the stress reducing feature 120a is an asymmetrical chamfered or contoured corner that transitions to the cover plate face 114 and the rotating disc face 112. In FIG. 6D, a retaining ring 110 is shown with stress reducing features 114a and 120a. In the illustrated embodiment, the stress reducing feature 114a is a scalloped surface within the cover plate face 114. Advantageously, the addition of scalloped surfaces on the retaining ring 110 can increase stiffness in desired areas, such as near the end gap portions 120. In FIG. 6E, a retaining ring 110 is shown with stress reducing features 112a and 120a. In the illustrated embodiment, the stress reducing feature 112a is a scalloped surface within the rotating disc face 112. In FIG. 6F, a retaining ring 110 is shown with stress reducing features 112a, 114a, and 120a. In the illustrated embodiment, the stress reducing feature 112a is a scalloped surface within the rotating disc face 112 and the stress reducing feature 114a is a scalloped surface within the cover plate face 114, wherein the stress reducing feature 114a is opposite to the stress reducing feature 112a.

[0038] Referring to FIGS. 7A-7F, various embodiments of the retaining ring 110 are shown. In FIGS. 7A-7F, an elevation view of the end gap portion 120 of the retaining ring 110 is shown. In FIG. 7A, a retaining ring 110 is shown with stress reducing features 115a. In the illustrated embodiment, the stress reducing feature 115a is a radiused corner that is tangent to the axially extending face 115. Further, the stress reducing feature 115a is disposed proximal to the end gap portion 120 of the retaining ring 110. In FIG. 7B, a retaining ring 110 is shown with stress reducing features 115a. In the illustrated embodiment, the stress reducing feature 115a is a scarf cut that can optimize loading of the cover plate 104. In FIG. 7C, a retaining ring 110 is shown with stress reducing features 115a and 115b. In the illustrated embodiment, the stress reducing feature 115a is a radiused corner that is tangent to the axially extending face 115 and disposed in the end gap portion 120 of the retaining ring 110. Further, the stress reducing feature 115b is a scarf cut that is disposed axially toward the cover plate face 114. In FIG. 7D, a retaining ring 110 is shown with stress reducing features 115a and 115b. In the illustrated embodiment, the stress reducing feature 115a is a radiused corner that is tangent to the axially extending face 115. Further, the stress reducing feature 115b is a scalloped surface that can optimize stiffness of the retaining ring. In FIG. 7E, a retaining ring 110 is shown with stress reducing features 115a and 115b. In the illustrated embodiment, the stress reducing feature 115a is a contoured corner. Further, the stress reducing feature 115b is a scalloped surface that can optimize stiffness of the retaining ring. In FIG. 7F, a retaining ring 110 is shown with stress reducing features 115a and 115b. In the illustrated embodiment, the stress reducing feature 115a is a radiused corner that is tangent to the axially extending face 115 and is disposed in the end gap portion 120 of the retaining ring 110. Further, the stress reducing feature 115b is a scalloped surface that can optimize stiffness of the retaining ring.

[0039] While the present disclosure has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the present disclosure is not limited to such disclosed embodiments. Rather, the present disclosure can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the scope of the present disclosure. Additionally, while various embodiments of the present disclosure have been described, it is to be understood that aspects of the present disclosure may include only some of the described embodiments. Accordingly, the present disclosure is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

[0040] The following clauses set out features of the present disclosure which may not presently be claimed in this application but which may form basis for future amendment of a divisional application.

1. A retaining ring for use in a gas turbine engine, the retaining ring comprising:

    a rotating disc face;
    a cover plate face; and
    an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

2. The retaining ring of clause 1, further comprising an axially extending face extending from the cover plate face.

3. The retaining ring of clause 2, wherein the axially extending face includes the stress reducing feature.

4. The retaining ring of clause 1, wherein the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

5. The retaining ring of clause 1, wherein the stress reducing feature is a contoured contact surface.

6. The retaining ring of clause 1, wherein the stress reducing feature is a scalloped surface.

7. The retaining ring of clause 1, wherein the stress reducing feature is a tapering surface.

8. A rotating disc assembly for use with a gas turbine engine, the rotating disc assembly comprising:

    a rotating disc;
    a cover plate; and
    a retaining ring disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, the retaining ring including:

        a rotating disc face to interface with the rotating disc;
        a cover plate face to interface with the cover plate; and
        an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

9. The rotating disc assembly of clause 8, further comprising an axially extending face extending from the cover plate face, wherein the axially extending face radially constrains the retaining ring against the cover plate.

10. The rotating disc assembly of clause 9, wherein the axially extending face includes the stress reduc-

ing feature.

11. The rotating disc assembly of clause 8, wherein the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

12. The rotating disc assembly of clause 8, wherein the stress reducing feature is a contoured contact surface.

13. The rotating disc assembly of clause 8, wherein the stress reducing feature is a scalloped surface.

14. The rotating disc assembly of clause 8, wherein the stress reducing feature is a tapering surface.

15. A gas turbine engine, comprising:

a rotating disc assembly, including:

a rotating disc;
a cover plate; and
a retaining ring disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, the retaining ring including:

a rotating disc face to interface with the rotating disc;
a cover plate face to interface with the cover plate; and
an end gap portion defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

16. The gas turbine engine of clause 15, further comprising an axially extending face extending from the cover plate face, wherein the axially extending face radially constrains the retaining ring against the cover plate.

17. The gas turbine engine of clause 16, wherein the axially extending face includes the stress reducing feature.

18. The gas turbine engine of clause 15, wherein the stress reducing feature is a radius tangent to at least one of the rotating disc face, the cover plate face, and the end gap portion.

19. The gas turbine engine of clause 15, wherein the stress reducing feature is a contoured contact surface.

20. The gas turbine engine of clause 15, wherein the stress reducing feature is a scalloped surface.

Claims

1. A retaining ring (110) for use in a gas turbine engine (10), the retaining ring comprising:

a rotating disc face (112);
a cover plate face (114); and
an end gap portion (120) defining an end gap, wherein at least one of the rotating disc face, the cover plate face, and the end gap portion includes a stress reducing feature.

2. The retaining ring (110) of claim 1, further comprising an axially extending face (115) extending from the cover plate face (114).

3. The retaining ring (110) of claim 2, wherein the axially extending face (115) includes the stress reducing feature.

4. The retaining ring (110) of claim 1, 2 or 3, wherein the stress reducing feature is a radius tangent to at least one of the rotating disc face (112), the cover plate face (114), and the end gap portion (120).

5. The retaining ring (110) of any preceding claim, wherein the stress reducing feature is a contoured contact surface.

6. The retaining ring (110) of any of claims 1 to 4, wherein the stress reducing feature is a scalloped surface.

7. The retaining ring (110) of any of claims 1 to 4, wherein the stress reducing feature is a tapering surface.

8. A rotating disc assembly (35) for use with a gas turbine engine (10), the rotating disc assembly comprising:

a rotating disc (102);
a cover plate (104); and
the retaining ring (110) of claim 1 disposed between the rotating disc and the cover plate, wherein the retaining ring axially retains the rotating disc and the cover plate, wherein the rotating disc face (112) interfaces with the rotating disc, and wherein the cover plate face (114) interfaces with the cover plate.

9. The rotating disc assembly (35) of claim 8, further comprising an axially extending face (115) extending from the cover plate face (114), wherein the axially extending face radially constrains the retaining ring (110) against the cover plate (104).

10. The rotating disc assembly (35) of claim 9, wherein the axially extending face (115) includes the stress reducing feature.

11. The rotating disc assembly (35) of claim 8, 9 or 10, wherein the stress reducing feature is a radius tangent to at least one of the rotating disc face (112), the cover plate face (114), and the end gap portion (126).

12. The rotating disc assembly (35) of any of claims 8 to 11, wherein the stress reducing feature is a contoured contact surface.

13. The rotating disc assembly (35) of any of claims 8 to 11, wherein the stress reducing feature is a scalloped surface.

14. The rotating disc assembly (35) of any of claims 8 to 11, wherein the stress reducing feature is a tapering surface.

15. A gas turbine engine (10), comprising:

the rotating disc assembly (35) of any of claims 8 to 13.

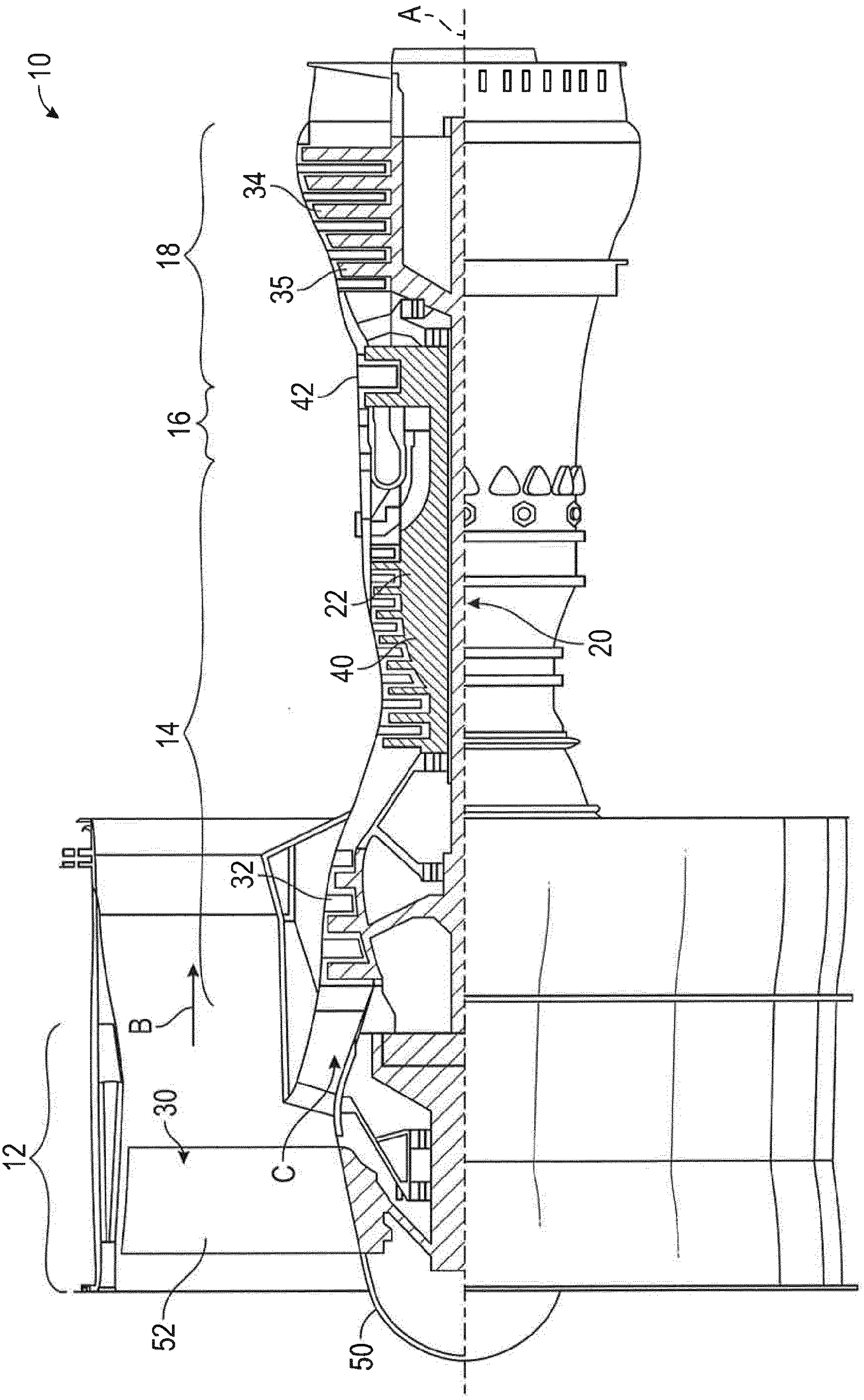

FIG. 1

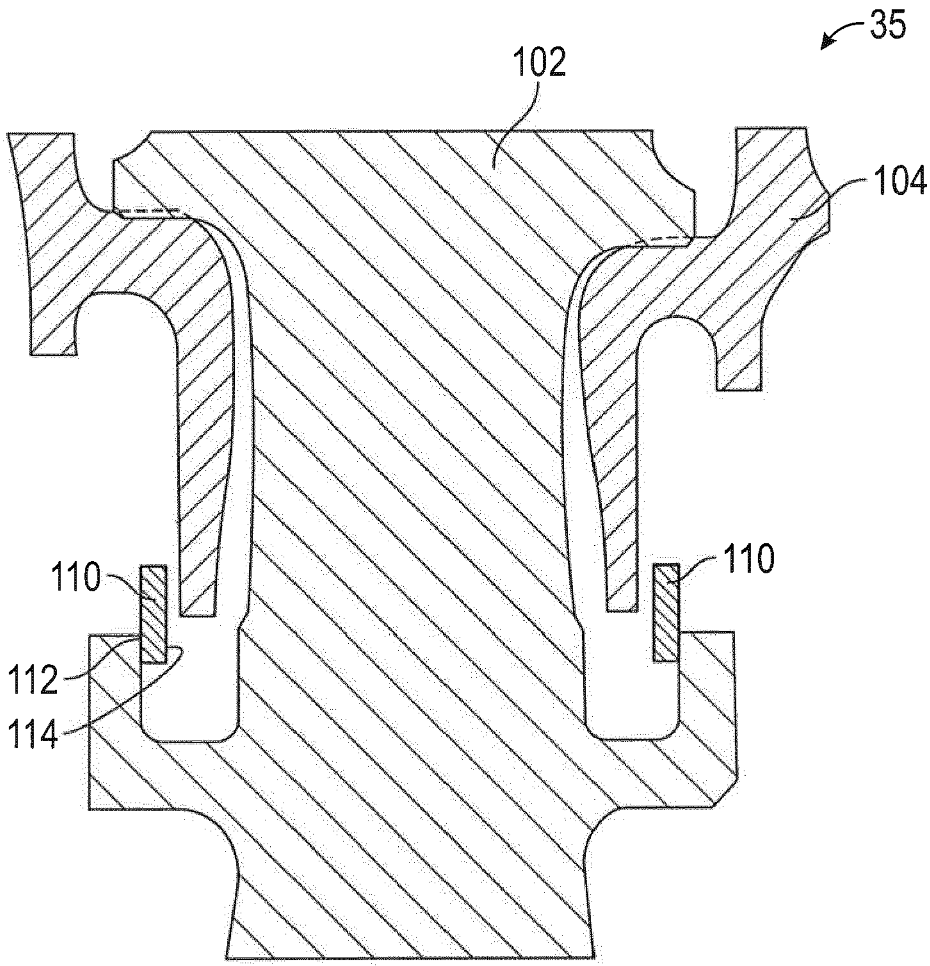

FIG. 2

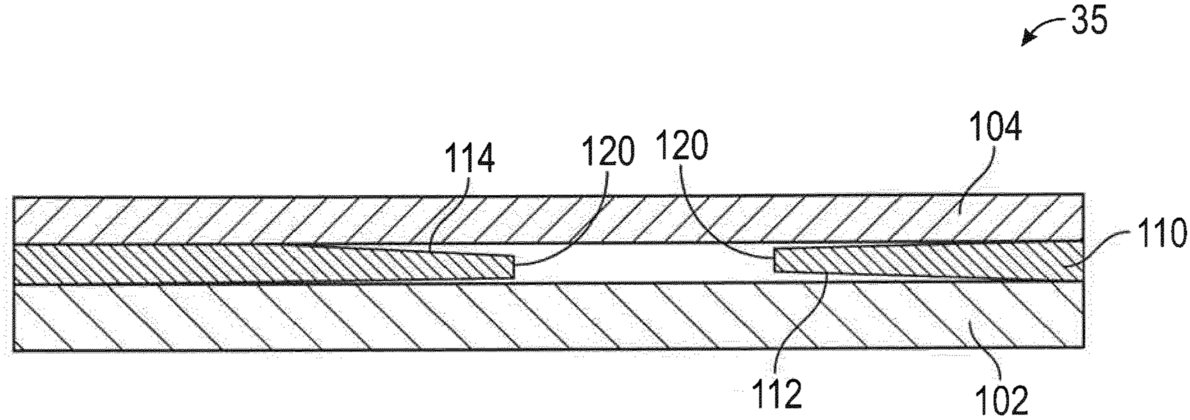

FIG. 3

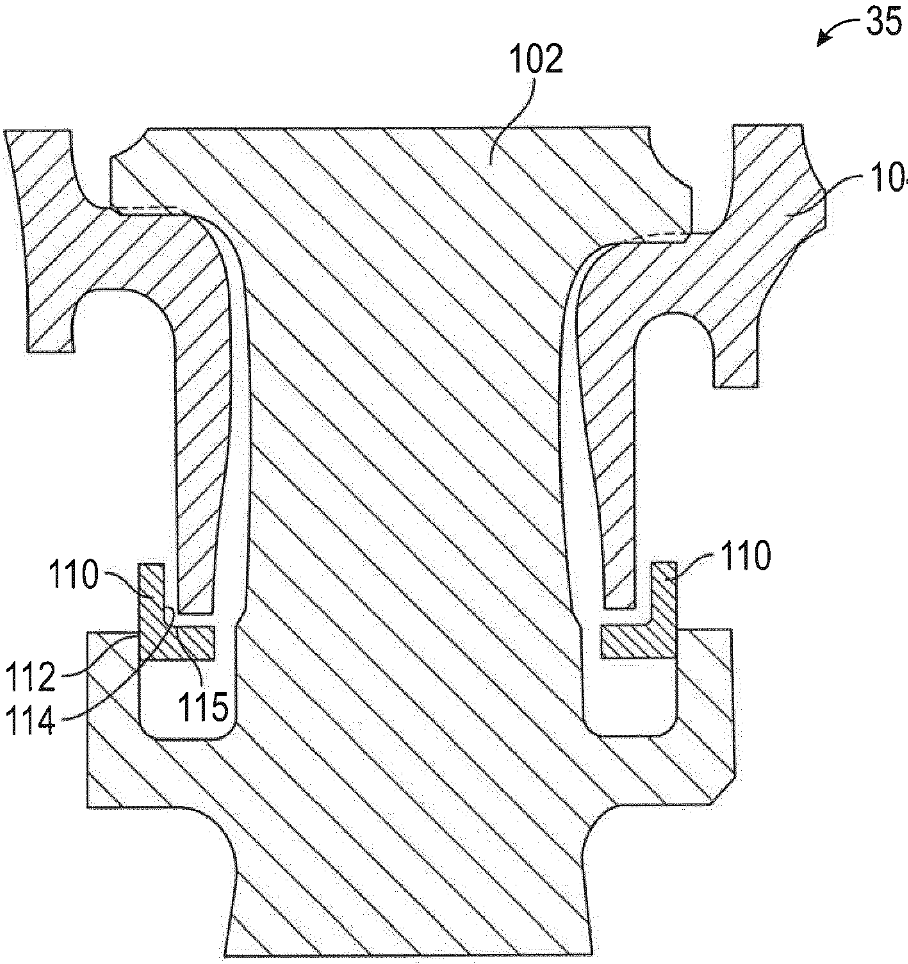

FIG. 4

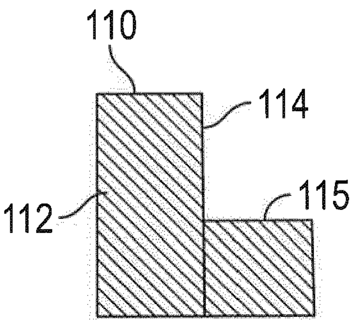

FIG. 5A

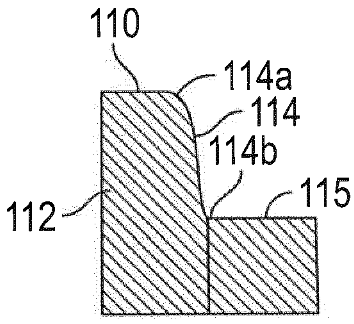

FIG. 5B

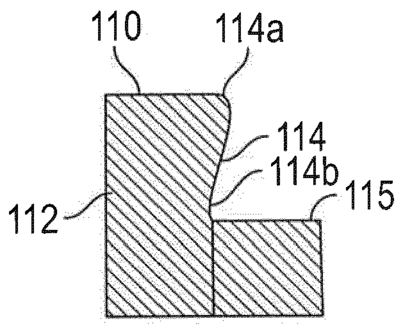

FIG. 5C

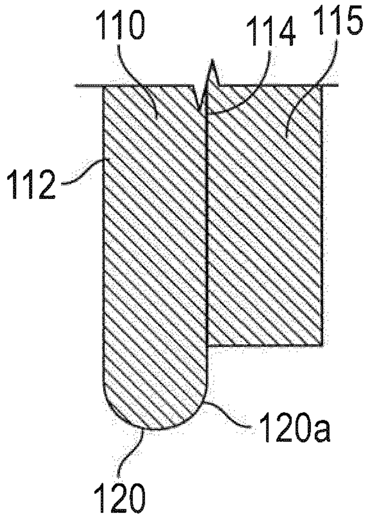

FIG. 6A

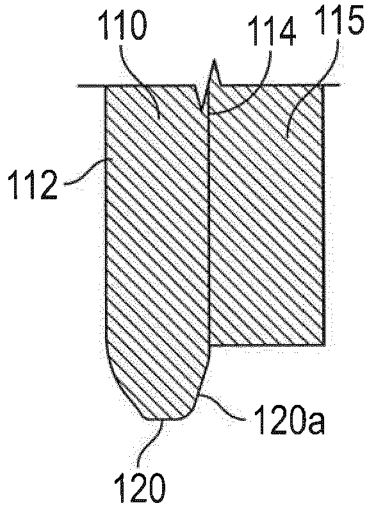

FIG. 6B

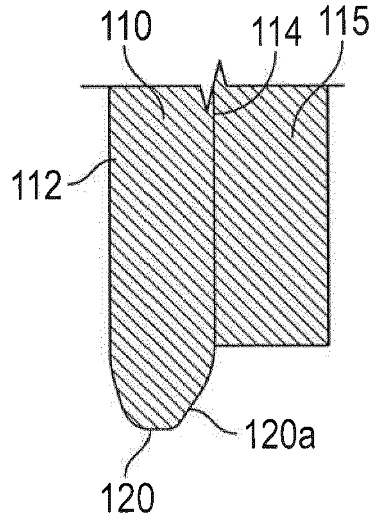

FIG. 6C

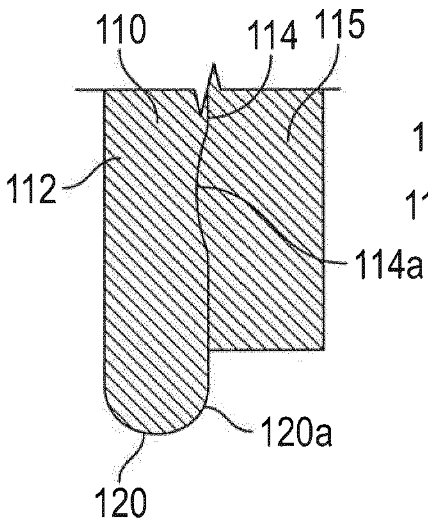

FIG. 6D

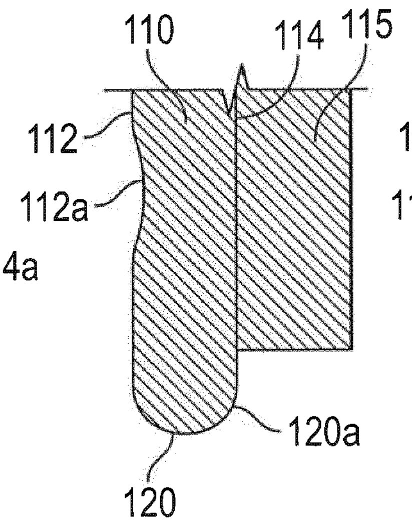

FIG. 6E

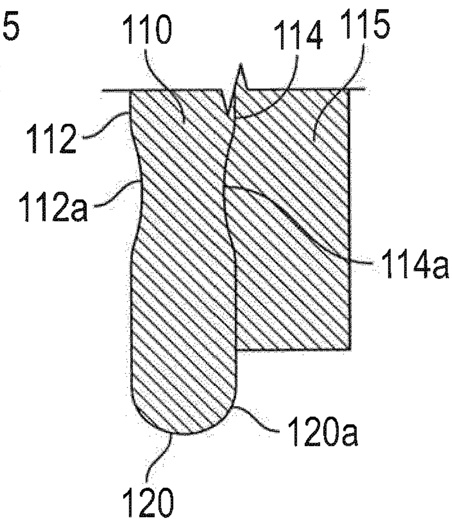

FIG. 6F

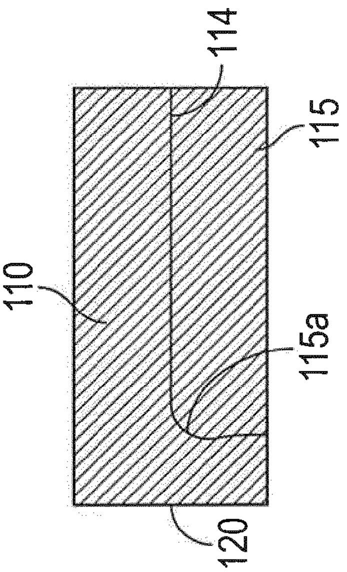

FIG. 7A

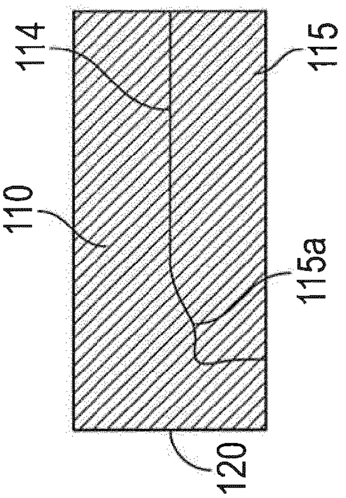

FIG. 7B

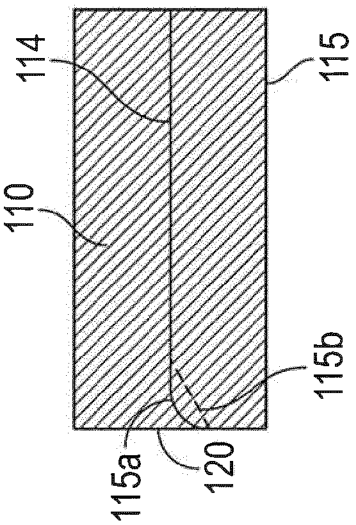

FIG. 7C

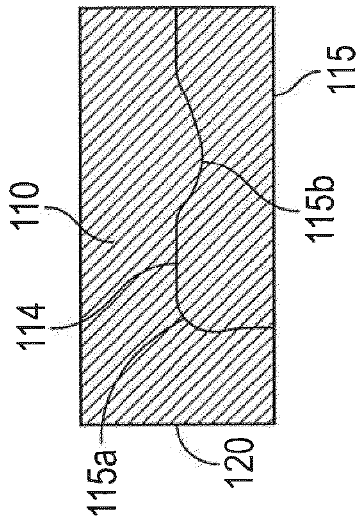

FIG. 7D

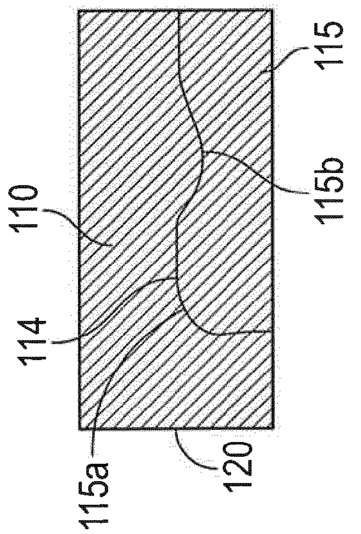

FIG. 7E

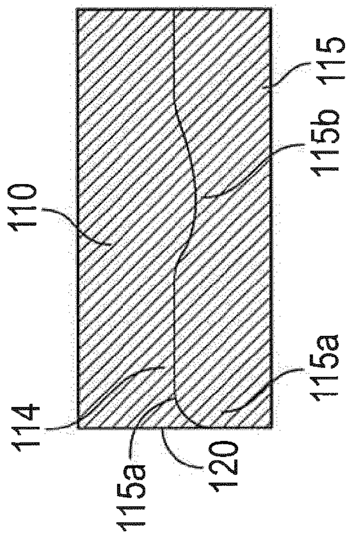

FIG. 7F

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EUROPEAN SEARCH REPORT

Application Number
EP 17 18 2485

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